# A Review of Tyson Foods Ammonia Refrigeration Engineering Specifications

Pursuant to

United States v. Tyson Foods, Inc., et al. Consent Decree

by

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# Executive Summary

This report documents the findings of a review (audit) of Tyson Foods Engineering Specifications related to their industrial refrigeration systems. This review has been prepared as a part of the United States v. Tyson Foods, Inc., et al. Consent Decree with the United States Environmental Protection Agency (EPA). In addition to specific information provided in this report, comments, suggested revisions, and other changes are provided directly on the electronic copies of the engineering specifications submitted as part of this review process. Finally, additional information in the form of technical articles and a master engineering specification for refrigerant piping systems has been provided to Tyson Foods, Inc. under separate cover for their consideration as they make revisions to their refrigeration-related engineering specifications.

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# Introduction

Per the requirements set forth in Appendix A Section 4.1 of Case 1:13-cv-00056-SNLJ *United States of America v. Tyson Foods, Inc. et al Consent Decree*, this report provides a summary of findings associated with a peer review of the Tyson Foods' Engineering and Design Specifications related to industrial ammonia refrigeration systems. The review was conducted to determine if there are provisions or requirements contained within the specifications that depart from industry-recognized codes, standards, and guidelines.

In the introductory section of this report, I provide an overview of relevant codes and standards including some of the complicating factors that arise given the landscape of the code development, adoption, and enforcement process across the United States and, specifically, in the four states that comprise U.S. EPA's Region 7. In addition, I discuss the concept of RAGAGEP and identify those codes, standards, and guidelines that formed the foundation for the present review. This section concludes with a discussion of engineering specifications, as they are commonly applied, in the industrial refrigeration sector.

## Codes and Standards

In the context of industrial refrigeration systems, the term "codes" generally refers to the legal requirements established by State or local regulations for buildings, mechanical systems, and electrical systems[1]. In this arena, States and local jurisdictions rarely write their own codes, rather they adopt, in-whole or in-part with modifications, documents that are referred to as "*model codes*." *Model codes* comprise set requirements for a given subject that can include application, design, and installation practices. Model codes are created by Standards Developing Organizations (SDOs) having appropriate subject matter expertise with the intent that they will be adopted by State and local governments to become legal and binding requirements. Ideally, a *model code* would meet the entirety of needs when adopted; however, some States and local governments adopt a standard, in the form of a model code, but proceed to make limited revisions to suit their requirements based on local needs.

The three SDOs that provide model codes for the States and local governments in Region 7 applicable to the design and installation of ammonia refrigeration systems include:

- International Association of Plumbing and Mechanical Officials (IAPMO) which develops and maintains:
    - The Uniform Mechanical Code (UMC)
    - and others

[1] In some States, Fire Codes are included as well.

- International Code Council (ICC) which develops and maintains a suite of model codes including:
    - The International Building Code (IBC)
    - The International Mechanical Code (IMC)
    - The International Fire Code (IFC)
    - and others
- National Fire Protection Association (NFPA) which is a nonprofit organization that, in part, develops and maintains:
    - The National Electric Code (NEC)
    - and others

In large part, the technical content for refrigeration-related model codes generally originate from "sister" SDOs such as IIAR or ASHRAE. The allied standards developed by SDOs such as IIAR and ASHRAE further reference other more technically complex standards developed by organizations such as the American Society of Mechanical Engineers (ASME) or National Fire Protection Association (NFPA). What results is a somewhat confusing set of standards with multiple organizations participating. With multiple standards and organizations involved, it is important to understand the concept of "pedigree" among of the standards so that the appropriate priority or emphasis can be placed where it is needed. Even more important is the fact that changes often occur first in the higher pedigree standards and time elapses before those changes work their way down into the lower pedigree dependent standards followed later by inclusion in the model codes. Eventually those changes reach the model codes adopted by the States and local governments; however, there is an additional lag created by the States and local government themselves since they are not compelled to automatically adopt new versions of model codes or standards when they are updated and periodically republished. This time lag can be illustrated by considering the current code requirements in force for the City of Emporia, Kansas. The City of Emporia currently recognizes the following related codes:

- Uniform Mechanical Code (UMC) – 2003 edition
- International Building Code (IBC) – 2006 edition
- Uniform Fire Code (IFC) – 2006 edition
- National Electrical Code (NEC) – 2005 edition

The most outdated of the current City of Emporia codes is their mechanical code (UMC-2003) which is ten years old. Since 2003, the SDO responsible for the UMC, IAMPO, has published three updated versions of that standard on a three year cycle including versions released in 2006, 2009, and the most recent in 2012.

In contrast to the mechanical code the City of Emporia has adopted, the State of Kansas currently recognizes the 2006 edition of the International Mechanical Code (IMC). The 2006 version of the IMC is only out of date by two revision cycles (2009 and 2012) rather than three. Needless to say, the precise code requirements that apply to a specific ammonia refrigeration system at a local level can best be described as a "patchwork." Overlaid on the varying versions of model codes that may be adopted at a State or local level is the realization that significant revisions to the higher pedigree standards often occur but, with the above-mentioned time lag, those changes can often take years to reach the codes in force at a local level. Practicing professionals are duty bound to use the latest and greatest information available, including standards within their practice. This can create further confusion as to what specific requirements apply for a given installation. In summary, the State or local codes in force for a given location establish bare **minimum** requirements. A new or modified installation that fails to meet the State or local code requirements would be "breaking the law."

*Standards* are developed by "Standards Developing Organizations" such as professional societies, trade groups, and other technical organizations that have both appropriate subject matter expertise and formal standards development and maintenance processes in place. *Standards* are written in a normative (mandatory) language format in order to avoid any ambiguity with respect to their requirements. The *standards* themselves may reference more detailed technical requirements contained within higher level engineering codes such as those prepared by the American Society of Mechanical Engineers (ASME).

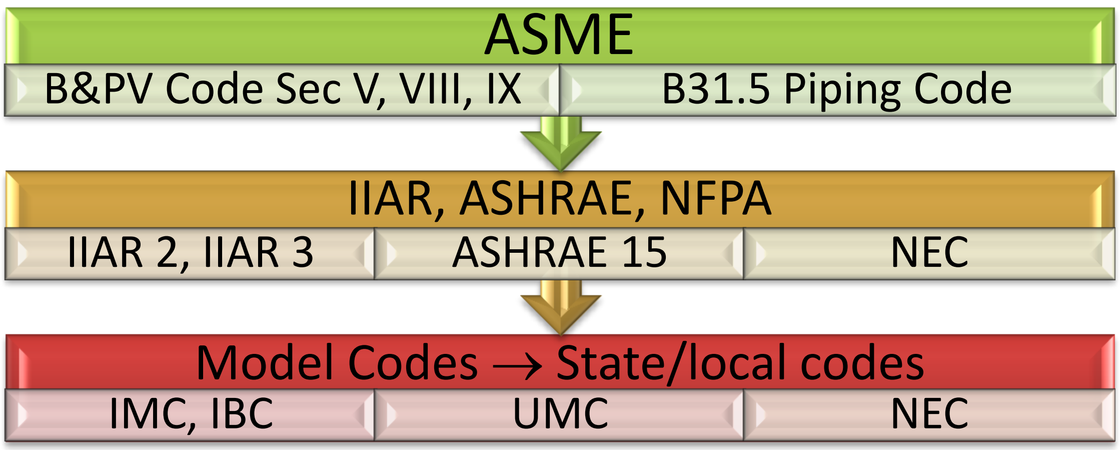
As noted above, *standards* provide the majority of the technical content that the model codes draw upon for their requirements. In some cases, the model codes may further simplify or narrow specific requirements/provisions found in the higher level standards in order to increase stringency or to streamline the code application and compliance process. By their nature, specific requirements periodically added or modified within *Standards* will eventually find their way into the codes in force at a local level.

Engineering professionals are expected to be up-to-date and current with requirements found in the *Standards* related to their field of work. Engineering professionals are also expected to have their work be consistent or compliant with the latest *standards* even when those requirements exceed those found in the lower level codes; however, it is understood that owners may reject the latest requirements and direct that the lagging codes establish the basis for requirements on a given project.

Out of this landscape of codes and standards arises a pedigree from the highest level to lowest level. Additional information on pedigree is provided in the next section on RAGAGEP.

## RAGAGEP

Both OSHA's Process Safety Management (PSM) and EPA's Risk Management Plan (RMP) standards set an expectation that covered processes will comply with "recognized and generally accepted good engineering practices" or RAGAGEP. From an engineering standpoint, there are a number of standards identifiable as RAGAGEP applicable to ammonia refrigeration systems. The interconnected nature of these standards or codes results in a relative "hierarchy" or "pedigree." The figure below illustrates a few of the related standards and their hierarchy. At the top of the list is ASME's Boiler and Pressure Vessel Code (Section V, Section VIII Division 1, Section IX) and the Refrigerant Piping Code (B31.5). Just below these are standards such as ASHRAE 15 and IIAR 2. These two refrigeration-specific standards both reference ASME as their source for the requirements that apply to pressure vessels and refrigerant piping. Next in the pedigree are the standards or model codes developed for adoption at the State and local level. These model codes draw upon standards such as ASHRAE 15 and IIAR 2 for their technical content.




## Specifications

An *engineering specification* is a document intended to establish an explicit set of requirements to be met in the design, construction, or installation of a product, system, or subsystem. Specifications set a uniform "standard" with which systems and equipment will be procured and made operational. Although the ammonia refrigeration industry has a number of related codes and standards, owners use engineering specifications to ensure that important details such as materials, design approaches, fabrication, assembly, testing, construction, and start-up are addressed in a prescriptive and consistent manner.

To prevent engineering specifications from becoming too voluminous and to avoid copyright issues, end-user specifications will frequently reference codes, standards, or guidelines to set forth the requirements that must be met for work within the specification's scope. Owner specifications may also include explicit requirements that are redundant with specific individual requirements appearing in the referenced standards or codes. When an owner elects to repeat of one or more individual requirements found in referenced standards or codes, the repetition is intended to reinforce a given requirement (or set of requirements) that the owner many have experienced gaps in compliance during past projects. The provision of some requirements in specifications can also set one or more requirements that go beyond what exists in codes and standards. When properly incorporated and enforced, the specification becomes an effective tool to ensure the greater stringency requirements are achieved. Given this background, the recommendations set forth in this report and accompanying materials provide specific additions to the Tyson Foods engineering specifications based on a number of recent changes that have been made to relevant codes or standards. In the case where such a code or standard may be referenced by a specification, these newer additions will be specifically called out in recommended changes to the specifications in order to minimize future compliance gaps on projects that arise due to the lack of familiarity of those changes among the audience for these specifications.

The audience that industrial refrigeration-related engineering specifications are aimed includes: professional engineers with overall refrigeration system design responsibility; contractors designing, constructing, and/or testing field-erected industrial refrigeration systems; and manufacturers of equipment for industrial refrigeration systems. With this audience, one should reasonably expect them to be familiar with and adhere to the codes in force for a given jurisdiction (state, county, or city) but their familiarity in this regard has been inconsistent.

## Project Scope

As stated in the Consent Decree, the intended scope for this specification review included (quote):

> **"Section 4. Audit Protocol**
>
> 4.1 The Auditor shall first conduct a paper review of Tyson's engineering and design specifications as they relate to the physical systems of the covered processes at the Facilities according to the schedule set forth in Section 5 of this Protocol. Specifically, the Auditor shall evaluate Tyson's ammonia refrigeration system engineering and design specifications PSM/RMP Program Manual for compliance with 40 C.F.R. § 68.65(d)(2),(3) and for consistency with the most current design codes and standards referenced below. Tyson uses and intends to continue to use engineering specifications that incorporate current guidelines so that any ammonia refrigeration system and/or project work satisfies refrigeration industry recognized and generally accepted good engineering practices ("RAGAGEP"). The design codes and standards are listed in the current PSM/RMP Program Manual as follows:
>
> - ANSI/ASHRAE 34 - Number Designation and Safety Classification of Refrigerants, American 3.12.4.1.2 Society of Heating, Refrigerating and Air Conditioning Engineers, Atlanta, GA
> - ASME Boiler and Pressure Vessel Code, Section VIII, American Society of Mechanical Engineers 3.12.4.1.4, New York, NY
> - ANSI/ASME B31.5, Refrigeration Piping, ASME, New York, NY
> - NFPA 70 - National Electrical Code, National Fire Protection Association, Quincy, MA
> - ANSI/ASHRAE 15- – Safety Code for Mechanical Refrigeration
> - ANSI/IIAR 2, IIAR 3, IIAR 5, IIAR Bulletins - 107, 108, 109, 110, 111, 112, 114, and 116, ARTG-GDL 1
>
> Additional location-specific codes may apply. The Auditor shall determine all local codes applicable to the covered processes at each Facility, including, but not limited to, the codes listed below:

- Building Code: Uniform Building Code
- Building Code: National Building Code
- Building Code: Southern Building Code
- Mechanical Code: Uniform Mechanical Code
- Mechanical Code: International Mechanical Code
- Plumbing Code: Uniform Plumbing Code
- Electrical Code: National Electric Code
- Fire Code: International Fire Code
- Fire Code: National Fire Protection Association Fire Code"

The RMP rule 40 CFR 68.65(d)(2) states:

> "The owner or operator shall document that equipment complies with recognized and generally accepted good engineering practices."

and 68.65(d)(3) states:

> "For existing equipment designed and constructed in accordance with codes, standards, or practices that are no longer in general use, the owner or operator shall determine and document that the equipment is designed, maintained, inspected, tested, and operating in a safe manner."

For the purposes of conducting the present review of Tyson Foods' latest engineering specifications, the most recent versions of codes and standards will be used as a basis for comparison. It is important to note that some of the RAGAGEP documents cited in the Consent Decree have since been withdrawn. An up to date and current list of codes, standards, and guidelines used as the basis for this engineering specifications review are included below in the section below titled "Applicable RAGAGEP."

## Definitions

The following are definitions applicable to the review of the Tyson Foods engineering specifications as-required by the Consent Decree:

> "**Deviation**"
>
> shall mean an item that the Auditor has judged to be a departure from or inconsistent with any applicable engineering and design specification, including current design codes and standards, and/or any refrigeration industry recognized and generally accepted good engineering practices at the time of the Audit. Deviations do not include items that are in present non-compliance with the applicable requirements of 40 C.F.R. Part 68. Any item that the Auditor has judged to be in present noncompliance with the applicable requirements of 40 C.F.R. Part 68 at the time of the Audit shall only be reported as a Finding, as defined below.

"**Finding**"

shall mean an item that the Auditor has judged to be in present noncompliance with the applicable requirements of 40 C.F.R. Part 68 at the time of the Audit.

For the purposes of this phase of the audit/review, all "deviations" would also be correspondingly considered as "findings" since 40 CFR 68.65(d)(2) requires that equipment comply with Recognized and Generally Accepted Good Engineering Practices (RAGAGEP). As a result, any provision within the current Tyson Foods Engineering Specifications reviewed that falls short of or is inconsistent with those requirements found in the applicable RAGAGEP identified below will be flagged as a "deviation" and sequentially marked throughout the report by: "***Deviation (letter)***". The above-mentioned hierarchy will be relevant where conflict may exist across given RAGAGEP. In this case, the higher pedigree standard or code will be used or referenced as the applicable RAGAGEP.

Oftentimes, engineering specifications establish individual requirements, groups of requirements, or other preferences that address the individual needs or preferences of owners. In many cases, these preference requirements are not at all linked specific requirements originating from a standard, code, or guideline; however, revisions to the specification may be in order to enhance clarity or to improve system safety, project performance, or project delivery. In this situation, specific recommendations will be made by the reviewer to enhance the specifications. These and other suggestions are being included in this review for Tyson Foods to consider in future revisions to its Engineering Specifications. This reviewer considers such recommendations are as non-mandatory (optional) and they are summarized in this report and sequentially marked by: "***Recommendation (number)***".

In section IV of the Consent Decree, a total of 23 facility locations were identified throughout the four States comprising EPA's Region 7 as shown in Table 1. As part of the audit protocol outlined in Appendix A of the Consent Decree, a search for the current local codes in force at each of the facility locations was conducted and the resulting summary of current codes for each location is included in

Table 2.

**Table 1: Facility locations identified in the Consent Decree.**

| State | City |
|---|---|
| Iowa | Cherokee |
| | Columbus Junction |
| | Council Bluffs |
| | Denison |
| | Perry |
| | Sioux City |
| | Storm Lake |
| | Waterloo |
| Kansas | Emporia |
| | Finney County |
| | Hutchinson |
| | Olathe |
| | South Hutchinson |
| Missouri | Concordia |
| | Dexter |
| | Monett |
| | Montgomery City |
| | Noel |
| | Sedalia |
| Nebraska | Dakota City |
| | Lexington |
| | Madison |
| | Omaha |

**Table 2: Codes in force at the facility locations as-identified in the Consent Decree.**

| City | State | Mechanical Code | Building Code | Electrical Code | Other Applicable Code |
|---|---|---|---|---|---|
| State of IA | | IMC (2009) | IBC (2009) | NEC (2008) | IFC (2009) |
| Cherokee | IA | IMC (2009) | IBC (2009) | NEC (2008) | IFC (2009) |
| Columbus Junction | IA | IMC (2009) | IBC (2009) | NEC (2008) | IFC (2009) |
| Council Bluffs | IA | IMC (2009) | IBC (2009) | NEC (2008) | IFC (2009) |
| Denison | IA | IMC (2009) | IBC (2009) | NEC (2008) | IFC (2009) |
| Perry | IA | UMC (1997) | UBC (1994) | NEC (1999) | - |
| Sioux City | IA | IMC (2006) | IBC (2006) | NEC (2005) | - |
| Waterloo | IA | IMC (2009) | IBC (2009) | NEC (2008) | IFC (2009) |
| Storm Lake | IA | IMC (2009) | IBC (2009) | NEC (2008) | - |
| State of KS | | IMC (2006) | IBC (2006) | NEC (2005) | IFC (2006) |
| Emporia[2] | KS | UMC (2003) | IBC (2006) | NEC (2005) | IFC (2006) |
| South Hutchinson | KS | IMC (2003) | IBC (2003) | - | - |
| Hutchinson | KS | IMC (2003) | IBC (2003) | NEC (2005) | - |
| Finney County | KS | IMC (2009) | IBC (2009) | NEC (2008) | IFC (2009) |
| Olathe | KS | IMC (2000) | IBC (2000) | NEC (1999 & 2000 Elec. Code Admin Provisions) | - |

[2] The City of Emporia has identified base codes that apply in its jurisdiction. In some cases, the City of Emporia has made revisions to one or more of these codes. The revisions are provided in a print publication by the City of Emporia titled "Building and Construction Regulations." In somewhat of a conflict, the cover page for this code book indicates that the contents includes "all amendments up to April 30, 2000"; however, the body of the document is referencing later codes e.g. 2007 IBC, IFC, and IMC.

| City | State | Mechanical Code | Building Code | Electrical Code | Other Applicable Code |
|---|---|---|---|---|---|
| State of MO | | None | | | |
| Dexter | MO | -[3] | | | |
| Sedalia | MO | IMC (2006) | IBC (2006) | NEC (2005) | - |
| Concordia | MO | IMC (2000) | IBC (2000) | ICC Electrical (2000) | IFC (2000) |
| Monett | MO | IMC (2006) | IBC (2006) | NEC (2005) | - |
| Montgomery City | MO | IMC (2009) | IBC (2009) | NEC (2011) | - |
| Noel | MO | - | BOCA (1993[4]) | | |

| | | | | | |
|---|---|---|---|---|---|
| State of NE | | IMC (2006) | IBC (2006) | NEC (2008) | NFPA 101 (2002) |
| Dakota City | NE | IMC (2006) | IBC (2006) | NEC (2008) | NFPA 101 (2000) |
| Lexington | NE | IMC (2009) | IBC (2009) | -[5] | IFC (2009) |
| Madison | NE | IMC (2006) | IBC (2006) | NEC (2008) | - |
| Omaha | NE | Omaha Municipal Mech. Code & portions of 2000 IMC & UMC | IBC (2006) | NEC (2005) | - |

[3] Dexter indicates no codes adopted but is a member of IBC 2006.
[4] Including subsequently issued updates.
[5] Any electrical work is permitted and inspected by the State of Nebraska.

Although not explicitly called for in the Consent Decree, Table 2 includes the related code requirements at a State level for Region 7. As stated earlier, the code requirements for given region is often "patchwork" that may consist of not only different model codes and different publication years. This fact is evidenced by a review of the local adopted codes for cities shown in Table 2. While some cities or states are reasonably current on their code requirements, others are lagging significantly. An example of the latter is Perry, IA where the mechanical code currently in force is from 1997.

For the purposes of my review of the Tyson Foods Engineering Specifications, the latest editions of industry codes, standards, and guidelines will be used. It would make no sense to utilize an engineering specification for a new installation or modifications to an existing installation based on older codes or standards.

## Applicable RAGAGEP

The Consent Decree identified a number of specific codes, standards and guidelines that were intended to be used as the RAGAGP basis in preparing this review. Unfortunately, some of the above-mentioned documents have been withdrawn or are not relevant. For example in September 2012, the IIAR Board of Directors formally withdrew Bulletin 111 (Machinery Room Ventilation) and Bulletin 112 (Ammonia Machinery Room Design). As such, the contents of Bulletins 111 and 112 will not be included in the RAGAGEP for the specification review[6]. In addition to RAGAGEP that may have been withdrawn, there are other documents cited in the Consent Decree that are simply not relevant to the review of Tyson Foods' engineering specifications for refrigeration systems. For example, IIAR "Ammonia Refrigeration Training Guideline" (ARTG-GDL1, 2007) is not relevant to the specification's subject matter; therefore, it will not be included in the list of documents that comprise RAGAGEP for this review.

The following are specific codes, standards, and guidelines that were included as a foundation during the review of the Tyson Foods Engineering specifications.

- **ASME B31.5**, "Refrigeration Piping and Heat Transfer Components", American Society of Mechanical Engineers, New York, NY, (2013).
- **ASME Section VIII, Division 1**, "Boiler and Pressure Vessel Code", American Society of Mechanical Engineers, New York, NY, (2010)[7].
- **ANSI/IIAR 2 (Including Addendum A)**, "Equipment, Design, and Installation of Closed-Circuit Ammonia Mechanical Refrigerating Systems", International Institute of Ammonia Refrigeration, Alexandria, VA (2008)[8].
- **ANSI/IIAR 3**, "Ammonia Refrigeration Valves", International Institute of Ammonia Refrigeration, Alexandria, VA (2012).

[6] It is also noteworthy that IIAR is planning on withdrawing additional guideline documents in the future as their contents transitions to existing or new IIAR standards.
[7] The full version of the 2007 code was used with a 2010 summary of revisions document. The release of the 2013 of the ASME B&PV Code is anticipated to be available in July 2013.
[8] Addendum A additions were published by IIAR 2 in 2010.

- **ANSI/IIAR 5**, "Start-up and Commissioning of Closed-Circuit Ammonia Mechanical Refrigerating Systems", International Institute of Ammonia Refrigeration, Alexandria, VA (2013)[9].
- **IIAR Bulletin 109**, "Guideline: Minimum Safety Criteria for a Safe Ammonia Refrigeration System", International Institute of Ammonia Refrigeration", (1997).
- **IIAR Bulletin 110**, "Guideline: Start-up, Inspection and Maintenance of Ammonia Mechanical Refrigerating Systems", (1993)[10].
- **IIAR Bulletin 114**, "Guideline: Identification of Ammonia Refrigeration Piping and System Components", (1993).
- **ANSI/ASHRAE 15**, "Safety Standard for Refrigeration Systems", ASHRAE, Atlanta, GA (2010)[11].
- **ANSI/ASHRAE 34**, "Designation and Safety Classification of Refrigerants", ASHRAE, Atlanta, GA (2010)[12].
- **NFPA 70**, "National Electrical Code" (NEC), National Fire Protection Association, Quincy, MA (2011).
- **IBC**, "International Building Code", International Code Council, (2012).
- **IFC**, "International Fire Code", International Code Council, (2012).
- **IMC**, "International Mechanical Code", International Code Council, (2012).
- **UMC**, "Uniform Mechanical Code", International Association of Plumbing and Mechanical Officials (IAPMO), Ontario, CA (2012).
- **NFPA 72®**, "National Fire Alarm and Signaling Code", National Fire Protection Association, Quincy, MA (2013).

As cited in several of the footnotes, several of the above-referenced RAGAGEP standards are pending reissuance to updated versions. This report will not discuss revisions that have occurred since the prior publication but there were a two particularly significant changes to ASHRAE Standard 34 that relate to ammonia and a short summary of those changes are included here for reference.

34.i. **Addendum d to Std. 34-2010** revised the toxicity classification for all refrigerants included in the standard. The criteria used as the basis for establishing whether a refrigerant is classified

[9] This is an anticipated publication year. IIAR 5 was approved for publication by the IIAR Board of Directors in June 2013. It is currently awaiting ANSI approval after which it will be formally released. This is expected before the end of 2013. The version used as part of the present review is the Board-approved draft-final.
[10] Includes Board of Director-approved revisions to sections 6.4 and 6.6.3 in 2004 and 2007, respectively.
[11] The 2013 edition of ASHRAE 15 will be available later this year. Approved addenda for the 2010 edition were included and those addenda will be fully incorporated into the 2013 edition.
[12] The 2013 edition of ASHRAE 34 will be available later this year. Approved addenda for the 2010 edition were included and those addenda will be fully incorporated into the 2013 edition.

as lower toxicity (Class A) or higher toxicity (Class B) is the OEL[13]. Class B refrigerants have an OEL less than 400 ppm. Ammonia is a Class B refrigerant.

34.ii. **Addendum h to Std. 34-2010** revised the flammability characteristic for ammonia as well as other "slightly flammable" refrigerants. A new flammability sub-classification "2L" was created. Refrigerants classified as 2L have a burning velocity less than or equal to 10 cm/s. Consequently, ammonia has a safety classification of B2L (higher toxicity/lower flammability).

The sections that follow summarize the findings and recommendations for each of the engineering specifications reviewed.

## Findings

This section summarizes the review findings of the Tyson Foods' engineering and design specifications for ammonia refrigeration systems and piping as-provided. The following engineering specifications were provided by Tyson Foods on June 30, 2013 and included in the review process:

**Table 3: Summary of the refrigeration-related engineering specifications reviewed.**

| Number | Description | Date | Revision |
|---|---|---|---|
| 15600 | GENERAL PROVISIONS FOR REFRIGERATION PIPING & SYSTEM INSTALLATION | 6/29/13 | R0 |
| 15601 | IDENTIFICATION OF AMMONIA REFRIGERATION PIPING AND SYSTEM COMPONENTS | 6/29/13 | R2 |
| 15602 | AMMONIA REFRIGERATION PRESSURE PIPING AND UTILITY PIPING | 6/29/13 | R5 |
| 15603 | AMMONIA REFRIGERATION INSULATION | 5/23/13 | R3 |
| 15604 | AMMONIA REFRIGERATION WELDING/NDE REFRIGERATION PIPING | 6/11/13 | R4 |
| 15684 | GUIDELINES FOR AMMONIA DETECTION SYSTEMS | 6/18/13 | R2 |
| 15685 | VENTILATION DESIGN CRITERIA FOR NEW AND EXISTING AMMONIA MACHINERY ROOM AND VESSEL ROOM | 12/27/12 | R3 |

Based on a review of the specifications, it appears that a revision control process for these specifications is in place and generally being followed as updates and changes are made to the specifications. This reviewer did note that some of the specifications reviewed had revision tables with dates, descriptions, and responsible party fields missing. For example, Revision 2 for specification 15604 did not include a

[13] The OEL is defined in Std. 34 as "***occupational exposure limit (OEL):*** the time-weighted average (TWA) concentration for a normal eight-hour workday and a 40-hour workweek to which nearly all workers can be repeatedly exposed without adverse effect, based on the OSHA PEL, ACGIH TLV-TWA, AIHA WEEL, or consistent value."

description, responsible party, or issue date. In this same specification, Revision 3 had responsible parties and date listed but no description of the revisions. This information is an important part of managing engineering specifications and there should not be any missing fields in a revision summary table. Specific gaps or similar deficiencies are noted for each respective specification.

*Recommendation (1)* *Tyson Foods Engineering should review its engineering specification revision processes to ensure that future specification revisions are properly documented, reviewed, approved, and issue-dated.*

Each specification document has headers and footers intended to reinforce the content and clarity contained within the document. In some cases, the listed revision date on the footer was not consistent with the actual listed revision date in the document revision table. Although this may not be necessarily viewed as a specification deficiency, such internal conflicts create confusion.

*Recommendation (2)* *Prior to issuing one or more engineering specifications on an individual project, Tyson Foods must ensure that the revision date included on the footer is consistent with the latest revision date listed in the revision log table. If the revision date and revision number are to be included in the document file name (as provided to this reviewer), those dates and revision numbers should also be checked for consistency before a specification is provided to the receiving party.*

There are two other recommendations this reviewer has to avoid mix-ups or deficiencies in complying with these engineering specifications on future projects.

Recommendation (3) *Include the phrase "End of Specification" at the conclusion of the text body for each specification. The purpose of including this phrase is to clearly convey to the reader that the specification text body has concluded.*

Recommendation (4) *For page numbering, use the "page # of total pages" type format (e.g. Page 5 of 23). This page number format provides a manner in which the reader can verify that they have all pages of the specification in its entirety.*

An issue noted with the Tyson Foods' engineering specifications included as part of the present review is that there are a number of cases of duplicative information provided. In some cases, the duplicative or redundant requirements occur within the four corners of an individual specification while in other cases, the duplication occurs across different specifications. Some duplication across engineering specifications may be necessary because the scope of a given project may not necessitate issuance of all specifications but this is often the exception. For example, specification 15685 (ventilation for machinery and vessel rooms) would not be issued for a project that involved outdoor piping. Although not necessarily considered as a deviation, specific examples of duplicate requirements within each specification will be highlighted and recommended edits included within the electronic versions of each specification.

In a manner similar to the structure and formatting of codes and standards, the provisions or requirements contained within engineering specifications must be both precise and unambiguous. An aspect related to precision relates to the formatting of elements within the specification. This reviewer noted the frequent use of bullet points across all of Tyson Foods' engineering specifications reviewed. To facilitate communication in a specification and to ensure precision, each provision or requirement must be uniquely identifiable; therefore, the use of bullet points should be avoided.

Recommendation (5) *Tyson Foods should revise its specifications to eliminate the use of bullet points. Each provision of its engineering specifications should be uniquely, explicitly and sequentially numbered (e.g. 1.2, 1.2.3.1,).*

With respect to ambiguity or vagueness, this reviewer noted that some of the engineering specifications reviewed included vague references and associated attempts to incorporate requirements from these references into the specification. For example, Section 1.6.3 of Specification 156000 references Factory Mutual recommendations relating to this portion of work being hereby incorporated into that specification. This type of vague reference is unacceptable because it is ambiguous and specification compliance/enforcement becomes impossible. Such blanket references noted during this review will be stricken.

Recommendation (6) *Refrain from using blanket references to guidelines, standards or other documents that create ambiguous requirements. If a guideline, standard, or other requirement from another organization is to be referenced, it must be done with a discernible document ID.*

In the sections that follow, the review findings for each of the above-mentioned engineering specification are provided. For each of the engineering specifications, more detailed comments, revisions, and other suggestions have been prepared and are being provided electronically under separate cover.

## Section 15600 – General Provisions for Refrigeration Piping and System Installation

This engineering specification is intended to provide general requirements for refrigerant piping and refrigeration system equipment installation. This specification has a significant amount of duplicative requirements within the specification and with other related specifications. Although not necessarily considered as a "deviation" or "deficiency", it would be highly recommended to eliminate such duplication. A number of examples of such duplication and recommended revisions are provided electronically in the separately submitted version of this specification.

Sections 1.5 and 1.7 in Specification 15600 refer to safety and required permits and licenses, respectively. This specification does not clearly articulate a requirement that bidding contractors shall be qualified and pre-approved by Tyson Foods' contractor program in accordance with 40 CFR 68.87 [which parallels 1910.119(h)]. Similarly, there is no flow-down provision for individual subcontractors to be reviewed and approved as part of Tyson Foods' contractor program (see §1.1.7).

Deviation (A) *Add a specific section to the specification titled "Approved Contractors" (or similar). In this section, explicitly state that bidding contractors must be pre-qualified through Tyson Foods' contractor program in accordance with the RMP rule 68.87(b) [which parallels the PSM Standard requirements found in 1910.119(h)(2)]. Within this section, also add that the bidding contractor is responsible for ensuring all its planned subcontractors shall be approved through Tyson Foods' contractor program. It would be appropriate to add a provision within the specification that notifies the contractor of their responsibilities/obligations consistent with the contract employer portion of the RMP rule 68.87(c) [which parallels the PSM standard 1910.119(h)(3)].*

Deviation (B) *There is no specific inclusion of requirements that the contractor must adhere to for minimum equipment clearances. Equipment clearance minimums may be established by: manufacturers, RAGAGEP, as-recommended from a pre-construction process hazard analysis, or from other authoritative sources.*

*An example of equipment clearance in RAGAGEP is §8.11.1 of ASHRAE 15-2010 where it states: "There shall be clear head room of not less than 7.25 ft (2.2 m) below equipment situated over passageways." Section 9.7.8 prescribes minimum clearances for the termination of pressure relief vents from adjoining ground level or from building window, ventilation opening, or exit.*

*In this specification, there should be an added requirement that the contractor must adhere to equipment clearances as-established by the equipment manufacturer, RAGAGEP, as-recommended from a pre-construction process hazard analysis, or by Tyson Foods.*

Attached to this report is an electronic version of Specification 15600 that includes a number of comments, clarifications, additions, deletions, and other recommendations. Because of their number, each of the individual changes will not be recited here but the reader is referred to the electronic version for those details.

## Section 15601 – Identification of Ammonia Refrigeration Piping and Systems Components

This engineering specification addresses the labeling and marking requirements for ammonia refrigeration piping and system components. The following summarize deviations found during the review of Section 15601.

*Deviation (C)* *Section 1.2.1 indicates that the pipe marking system shall conform to ANSI A13.1-1996. There are three issues with this established requirement. First, the correct standard reference is: ANSI/ASME A13.1 – "Scheme for the Identification of Piping Systems." Second, there have been several editions since the cited 1996 version. The current edition of this standard was published in 2007. Third, ANSI/ASME A13.1 is too general for ammonia refrigeration systems given that IIAR has an established guideline for identification of ammonia piping and equipment (Bulletin 114).*

These issues notwithstanding, Section 1 of ANSI/ASME A13.1-2007 does indicate that one can comply with this standard if the alternate marking schemes: (a) are described in writing (b) employees are trained as to the operation and hazards of the piping systems. IIAR Bulletin 114[14] meets the Section 1(a) requirement above. If Tyson Foods appropriately includes the operation and associated hazards of its ammonia piping systems and equipment as part of employee training as-required by 40 CFR 68.71 [1910.119(g)], the Section 1(b) requirement would also be met.

This reviewer is recommending that Tyson Foods use IIAR Bulletin 114 as the basis for its pipe marking and equipment labeling. Much of the pipe labeling and equipment requirements included in 15601 is consistent with Bulletin 114.

*Deviation (D)* *Section 1.1.5 of this Specification 15601 references that the identifying designations "shall be consistent with the nomenclature used for the Process and Instrument Diagrams <u>being developed</u> under the Tyson Foods, Inc. Process Safety Management Program." The underlined portion of this quote was highlighted for emphasis. This*

[14] IIAR 114, "Guidelines for Identification of Ammonia Refrigeration Piping and System Components", International Institute of Ammonia Refrigeration (1991).

*is a deviation because one cannot comply with nomenclature or other requirements that have not yet been developed. If the nomenclature system is finalized and available, this section needs to be revised accordingly otherwise, this requirement must be deleted. This same deviation applies to section1.2.14.1 of Specification 15601.*

*Deviation (E)* *Section 1.2.1 (first bullet) of Specification 15601 specifies that pipe line markers shall be placed at change of direction and at approximately 25 foot increments. The RAGAGEP provided in Bulletin 114 states the following:*

*"Piping markers shall be located as follows:*

- *a. before and after a change in piping direction*,
- *b. before and after piping penetrations of walls, ceilings and floors,*
- *c. on extended horizontal or vertical runs of pipe, with a maximum spacing of 40 feet between markers, in order to provide positive identification, and*
- *d. at least once on the piping in every area through which the refrigeration piping passes."*

*Items a, b, and d above are currently covered in Specification 15601 under §3.2.10, §3.2.5, and §3.2.11, respectively. It does not appear that item c. is included in the current specification.*

*Section 1.2.1 should include numbered subsections (rather than bullets) that explicitly cover items a-d above. Tyson Foods is encouraged to maintain its 25 ft maximum span between pipe labels vs. the 40 ft span as required by Bulletin 114. In addition, there is some internal redundancy for marking requirements (see sections 1.2.1 and 3.2 of 15601). To avoid future internal conflict of requirements within the specification, consider consolidating all pipe marking location requirements into one section.*

*Deviation (F)* *The first bullet under Section 1.2.13.1 of Specification 15601 indicates that the size of pipe markers and the lettering is determined by two factors but only one factor is listed. IIAR 114 lists the two factors as (a) the outside diameter of the pipe, including insulation on insulated pipe and (b) the distance between the viewer and the pipe.*

Attached to this report is an electronic version of Specification 15601 that includes a number of comments, clarifications, additions, deletions, and other recommendations. Because of their number, each comment not be individually recited here but the reader is referred to the electronic version for those details.

## Section 15602 –Ammonia Refrigeration Pressure Piping and Utility Piping

This engineering specification addresses the requirements associated with the furnishing of labor, material, and equipment necessary to install ammonia refrigeration pressure piping and other related utility piping such as evaporator defrost condensate drain lines or instrument air lines. The following summarize deviations found during the review of Specification 15602.

*Deviation (G)* *Section 1.3.1 of Specification 15602 states "All piping systems, components of such systems, and the assembly and testing of such systems shall meet or exceed the minimum requirements of all references." In addition to there being defects in the cited references as noted below, refrigerant piping systems need to meet or exceed the requirements found in ASME B31.5 – period.*

*Section 9.10.1 of ASHRAE 15-2010 states:*

> *"Refrigerant piping, valves, fittings, and related parts having a maximum internal or external design pressure greater than 15 psig (103.4 kPa gage) shall be listed either individually or as part of an assembly or a system by an approved, nationally recognized laboratory <u>or shall comply with ASME B31.5 where applicable</u>."*

*Section 10.1 of IIAR 2-2008 (including Addendum A) states:*

> *"The design, materials, fabrication, examination, and testing of the piping, whether fabricated in a shop or as a field erection, shall comply with ASME B31.5-2006, Refrigeration Piping [ref.4.1.2], except where noted."*

*The requirements in Tyson Foods Specification 15602 should align to the current version of ASME B31.5 as noted in the next deviation.*

*Deviation (H)* *Section 1.3 of Specification 15602 does reference ASME B31.5 and, although refrigerant piping systems must comply with this standard, the citation is defective because (1) the title, as-shown in the specification, is incorrect and (2) there is no specific year/edition for the standard cited. As such, it is impossible to comply with this as a referenced standard. The appropriate and correct reference is:*

*ASME B31.5, "Refrigeration Piping and Heat Transfer Components", American Society of Mechanical Engineers, New York, NY, (2013).*

*Recommendation (7)* *Because the requirements for different types of piping are variable, this reviewer recommends that Tyson Foods segment out and differentiate the specific requirements for the following types of piping accordingly:*

*i.* ***Refrigerant piping*** *shall comply with B31.5. The specification could also require compliance with the piping provisions of IIAR 2 as a lower level standard.*

*ii.* ***Secondary fluid piping*** *shall comply with B31.5 since this type of piping is also included in the scope of B31.5.*

*iii.* ***Equipment piping*** *for evaporative condensers, air units, etc. If Tyson Foods has other equipment-related specifications that cover these types of refrigeration equipment, those specifications shall prescribe that the piping therein comply with B31.5.*

*iv.* ***Relief vent piping*** *is outside of the scope of B31.5 since it is not pressure piping. There is RAGAGEP for relief vent piping materials in both ASHRAE 15 and IIAR 2. There is also RAGAGEP for the engineering (sizing) for the application of relief protection and sizing of relief vent piping. The requirements for overpressure protection of ASME stamped vessels and equipment originates from ASME the ASME Boiler and Pressure Vessel Code Section VIII Division 1.*

*Differentiating the various types of piping within the engineering Specification 15601 (and others) will allow the respective requirements for each type of piping to be more effectively conveyed.*

*Deviation (I)* *Section 1.8 of Specification 15602 is out of scope for this the intended purpose of this specification.*

*Deviation (J)* *Section 3.6 of Specification 15602 refers to an out of date standard. The current RAGAGEP for pipe support elements is in ASME B31.5 (2013) Section 520. Section 520 should be referenced in this specification as the requirement for pipe support. In addition, IIAR 2-2008 (including Addendum A) provides an informative appendix on pipe support as well (see Appendix F: Pipe Hanger Spacing, Hanger Rod Sizing, and Loading).*

*Deviation (K)* *Section 3.28.4 of Specification 15602 correctly specifies the test pressure at 110% of the design pressure; however, the language included is ambiguous since it prescribes a high-side target of 250 psig and a low-side target of 150 psig. Section 538.4.2 of ASME B31.5 (2013) requires the following: "(e) The pneumatic test pressure used shall be at least 110% of the design pressure. The test pressure shall not exceed 130% of the design pressure of any component in the system."*

*The test pressure in Specification 15602 needs to be clearly and explicitly stated. At a minimum, consider including the following:*

| ***Design pressure (psig)*** | ***Test Pressure (psig)*** | |
|---|---|---|
| | ***Minimum*** | ***Maximum*** |
| *150* | *165* | *195* |
| *250* | *275* | *325* |
| *300* | *330* | *390* |

As a point of information, IIAR 2-2008 (including Addendum A) requires the low-side design pressure to be at least 150 psig and the high-side design pressure for water-cooled or evaporatively condensed systems to be at least 250 psig. Low-side components such as air-cooling evaporators that will utilize hot-gas defrost must be designed for 250 psig working pressure (IIAR 2 section 8.1.1.1). Controls (except for low-side) must be designed for 300 psig pressure (IIAR 2 section 12.2.1.2).

*Deviation (L)* *Section 3.28.4 of Specification 15602 (second bullet) indicates that leak testing shall be conducted while at the test pressure. This is not in compliance with AMSE B31.5. Section 538.4.3 covers leak testing and it states: "After the pressure test in para. 538.4.2 is completed, a leak test shall be performed." "(c) The pressure used for leak tests shall be either the design pressure or a pressure specified in the engineering design." In other words, the test pressure shall be at least 110% but not more than 130% of the design pressure. Following a successful pressure test, the pressure is reduced to the design pressure (which is less than the leak test pressure) so leak checking can commence.*

*Deviation (M)* *Section 3.28.4 of Specification 15602 (third bullet) suggests that a Tyson Foods representative can authorize a lower leak test pressure. This reviewer cannot identify any RAGAGEP basis that would permit such an authorization. Section 538.4.2(b) of ASME B31.5 (2013) does permit a preliminary test at a gauge pressure up to 25 psig as a means of identifying major leaks. If this is what was intended in* *the specification, it needs to be modified accordingly and moved up closer to the top of this section on pressure testing.*

*Deviation (N)* *Section 3.28.4 of Specification 15602 (last bullet) indicates that, in rare cases, ammonia may be required for performing a leak test. Section 15.1.6.2 of IIAR 2-2008 (including Addendum A) specifies: "Dry nitrogen or compressed air or a combination of compressed air and dry nitrogen shall be used to raise the pressure in the ammonia system to that required…" Although it does not explicitly prohibit ammonia vapor or ammonia/nitrogen mixtures from being used as a pressure test medium, it does not identify it as allowable. Should Tyson Foods want to retain this provision, this reviewer would recommend requesting a formal interpretation of this requirement from IIAR.*

*Deviation (O)* *Section 3.31 of Specification 15602 prescribes a test pressure of 250 psig that is not consistent with the listed design pressure of 300 psig. Test pressure shall be not less than 110% of the design pressure and not greater than 130% of the design pressure.*

Attached to this report is an electronic version of 15602 that includes a number of comments, clarifications, additions, deletions, and other recommendations.

## Section 15603 –Ammonia Refrigeration Insulation

The RAGAGEP related to insulation for industrial ammonia refrigeration piping and equipment is minimal. Section 14.3 of IIAR 2-2008 (including Addendum A) simply states that "Suction lines, low-temperature liquid lines, accumulators, surge drums and similar cold surfaces shall be insulated to prevent condensation and corrosion." This section allows an exception for valve groups to be left uninsulated for access to service.

In summary, the Specification 15603 is excellent! The document is very thorough and explicit in its detail on materials and methods. This reviewer had just a few comments and suggestions that are included in the electronic version of this specification.

## Section 15604 –Ammonia Refrigeration Welding/NDE Refrigeration Piping

This engineering specification addresses requirements related to the welding fabrication for industrial refrigeration piping. Section 527 of ASME B31.5 (2013) establishes requirements associated with welding refrigerant and other piping within the scope of the code. As such, ASME B31.5 forms the

RAGAGEP basis for this specification. The following summarize deviations found during the review of Section 15604.

First, a general comment related to this specification. This specification includes an inordinate amount of detail. In some cases, the details included are technically incorrect. In other cases, the details included create internal conflicts with other provisions of the specification. As an example, consider Section 2.1 on filler metals. Section2.1.1.2 identifies a E6010 stick electrode as unacceptable for pressure-retaining welds but Section 3.1.5.4 requires the root pass be made with a E6010 electrode. Although not essential to include details on filler metals because section 527.1.1 of B31.5 already establishes the requirements, the technical content on filler materials in this section, if retained, needs to be reviewed and revised accordingly. My recommendation is to eliminate most or all of this detail and, should you want to restrict certain filler metals, use the submittal review process as an opportunity to reject welding procedure specifications (WPS) that include those filler metals you want to avoid.

*Deviation (P)* *Section 3.4.4 of Specification 15604 specifies that piping alignment shall be "as accurately as practical." Section 527.2.1 of B31.5 (2013) establishes alignment requirements and limits the misalignment. This is a requirement for complying with the code so specifying "accurately as practical" is not consistent with B31.5.*

*Deviation (Q)* *Section 3.11.3 of Specification 15604 indicates that welding shall not be done if the ambient temperature is lower than 0°F. This temperature deviates from the requirements in ASME B31.5. Section 527.3.1 of ASME B31.5 (2013) states that "No welding shall be done if the weld area is wet or exposed to high wind or at a metal temperature below 32°F (0°C)."*

During the course of reviewing this specification, a number of internal conflicts have been identified as well as other changes that would help with clarifying the intended requirements. Attached to this report is an electronic version of 15604 that includes comments, clarifications, additions, deletions, and other recommendations.

## Section 15684 – Guidelines for Ammonia Detection Systems[15]

This engineering specification covers ammonia detection system requirements for ammonia machinery rooms, non-refrigerated areas (i.e. a vessel room), refrigerated areas, and make-up air units. The following summarize deviations found and recommendations developed during the review of Section 15684.

[15] This specification would more appropriately be titled "Ammonia Detection Systems"

*Deviation (R)* *Section 1.5.2 of Specification 15684 identifies ammonia as a group B2 refrigerant per ASHRAE 34. This is no longer correct since Addendum h to ASHRAE Standard 34 revised the flammability class for ammonia. The correct safety classification for ammonia is now "B2L."*

Although ASHRAE Standard 34 has revised the safety classification of ammonia (and other slightly flammable refrigerants), ASHRAE Standard 15 has not yet approved revisions to mechanical equipment rooms or other types of spaces to address the new flammability sub-classification. Expect those changes to occur following the publication of the 2013 edition of ASHRAE Standard 15.

*Recommendation (8)* *Section 1.9.1 of specification 15684 states that the ammonia readout panel shall be located outside of the engine room and that the enclosure can be a NEMA-1. Recommend that you revise this requirement to be more specific with the enclosure requirement for various possible locations for the panel. For example, if "outside the engine room" becomes an outdoor location, a NEMA-1 class panel would not be acceptable (likely a NEMA-4 as a minimum).*

*Deviation (S)* *Section 1.9.1.1 of specification 15684 covers detection of ammonia at or above 25 ppm. This specification section does not establish a requirement for transmitting the alarm to an approved location as required by Section 606.8 of the IFC (see also section 13.2.1.1 of IIAR 2). The same comment applies to Section 1.9.1.2.*

*Recommendation (9)* *Section 1.9.1.3 of specification 15684 establishes requirements for the actuation of engineering controls at a sensed ammonia concentration of 20,000 ppm (2%). Section 2.3.2.1 of 15684 specifies the range of the detector to be 0-20,000 ppm. This reviewer would recommend not establishing a trigger point for engineering control that is at the upper span of the specified sensor. Consider a lower trigger concentration of ca. 16,000 ppm or thereabouts but avoid triggering at the end of the sensor's span. This is also consistent with the requirements for emergency control in Section 1109.4 of the UMC (2012).*

*Recommendation (10)* *Sections 2.2.3 and 2.3.2.2 of Specification 15684 appear to be missing requirements. Review and add the supporting requirements.*

Although not specifically pertinent to this engineering specification, it is noteworthy to point out that Section 606.6.1 “Periodic Testing” of the International Fire Code (2012) requires detection and alarm systems to be periodically tested in accordance with manufacturer’s instructions and as required by the fire code official. This operational requirement is consistent with mechanical integrity requirements found in 40 CFR 68.73 [consistent with the requirements in 1910.119(j) for PSM-covered facilities].

Somewhat related to refrigerant detector-actuated engineered safety, *machinery room shutdown*, function required by this specification is the associated and code-required administrative control for manual shutdown of the machinery room. Although this specific requirement was not incorporated into Specification 15684, each machinery room requires remote controls for the manual shutdown of equipment and appliances located in a machinery room. If this requirement is not explicitly called for in a separate Tyson Foods engineering specification, it becomes essential for Tyson Foods to incorporate this requirement into its engineering designs or work scopes for machinery room spaces. Here is a summary of the administrative control for the machinery room shutdown requirements found in the RAGAGEP.

- Section 606.9.1 of the IFC (2012) and Section 1106.5.1 of the IMC (2012)
    - “A clearly identified switch of the break-glass type or with an approved tamper-resistant cover shall provide off-only control of refrigerant compressors, refrigerant pumps and normally closed automatic refrigerant valves located in the machinery room.”
- Section 13.1.13.2 of IIAR 2-2008 (including Addendum A)
    - “A remote emergency shutdown control for refrigerant compressors, refrigerant pumps, and normally closed automatic refrigerant valves within the machinery room, shall be provided immediately outside the designated principle exterior machinery room door. The remote control shall be a clearly identified switch of the break glass type or with an approved tamper resistant cover, and it shall provide emergency off only control.”
- Section 8.12(i) of ASHRAE 15-2010
    - “Remote control of the mechanical equipment in the refrigerating machinery room shall be provided immediately outside the machinery room door solely for the purpose of shutting down the equipment in an emergency. Ventilation fans shall be on a separate electrical circuit and have a control switch located immediately outside the machinery room door.”
- Section 1109.4 of the UMC (2012)
    - “A clearly identified switch of the break-glass type or with an approved tamper-resistant cover shall be provided immediately adjacent to and outside of the principal refrigeration machinery room exit. The switch shall provide off-only control of refrigerant compressors, refrigerant pumps, and normally-closed, automatic valves located in the machinery room. The switch shall be automatically shutoff where the

refrigerant vapor concentration in the machinery room exceeds the vapor detector's upper detection limit or 25% of the LFL, whichever is lower."

Attached to this report is an electronic version of 15684 that includes comments, questions, additions, deletions, and other recommendations.

## Section 15685 – Ventilation Design Criteria for New and Existing Ammonia Machinery Room and Vessel Room

This engineering specification specifies requirements for the engineering design of ammonia exhaust and intake systems for newly constructed or modifications to existing machinery rooms or vessel rooms. Section 1.5.3 of this specification requires the use of Tyson Foods Engineering's "*Ammonia Machinery Room Ventilation Worksheet*." This worksheet was not included as part of the present review of Tyson Foods' engineering specifications.

The following summarize deviations found and recommendations developed during the review of Section 15685.

*Deviation (T)* *Section 1.5.2 of Specification 15685 identifies one fan as an option for machinery room ventilation. To comply with the machinery room ventilation requirements of IIAR 2-2008 (including Addendum A), at least two fans are required.*

*Deviation (U)* *Section 1.5.2 of Specification 15685 provides some specificity for location of inlet air to machinery room spaces but it does not reflect the requirements of Section 1108.3 of the UMC which are consistent with good engineering practices for machinery room ventilation.*

*Section 1108.3 of the UMC (2012) states: "Exhaust inlets or permanent openings shall be located to provide ventilation throughout the entire refrigeration machinery room."*

*Section 1108.9 of the UMC (2012) states: "Makeup air intakes to replace the exhaust air shall be provided to the refrigeration machinery room directly from outside the building. Intakes shall be located as required by other sections of the code and fitted with backdraft dampers or other approved flow-control means to prevent reverse flow. Distribution of makeup air shall be arranged to provide thorough mixing* *within the refrigeration machinery room to prevent short circuiting of the makeup air directly to the exhaust."*

*Recommendation (11)* *Section 1.5.4 of Specification 15685 is intended to identify the quantity of ventilation air to be exhausted from a machinery room in the event of a leak. None of the subsections (1.5.4.1-1.5.4.3) relate to machinery room ventilation rates. All of the subsections to 1.5.4 relate to functional requirements for machinery room ventilation systems. This section needs to be revised accordingly.*

*Deviation (V)* *Equation 11-1 of Specification 15685 is incorrect. Section 8.11.5 of ASHRAE 15-2010 shows the free opening area shall be calculated as:*

$F = G^{0.5}$ *(IP units)*

*Recommendation (12)* *Section 1.5.13 of Specification 15685 has provisions for turning off emergency ventilation fans for a machinery room and this requirement is consistent with override control in Section 13.3.11.4 of IIAR 2-2008. At present, IIAR does not have an interlock requirement to shut down the electrical equipment within the machinery room when the "off" override of machinery room emergency ventilation is activated. Recommend interlocking the electrical shutdown of your machinery rooms to be tripped when ventilation fans are turned off using the override. This interlock is intended to remove potential ignitions sources that are electrical in nature in order to reduce the probability of a deflagration because, in the event of an incident, the concentration of ammonia in the machinery room will rise when ventilation fans are cycled off.*

*Deviation (W)* *Section 1.5.7 of Specification 15685 calls for the use of two fans for machinery room ventilation. Determination of the emergency exhaust CFM requirements needs to be revised in order to accommodate Section 13.3.2 of IIAR 2-2008 (including Addendum A). This provision within IIAR 2 requires that the failure of any single fan to not diminish the machinery room ventilation rate to less than 20 ACH. This means a machinery room equipped with two exhaust fans would necessitate each has a design ventilation rate of 20 ACH for a machinery room total of 40 ACH.*

*Deviation (X)* *Section 1.6 of Specification 15685 provides an alternate method for determining the ventilation rate for "Vessel Rooms." If the vessels located within these spaces include pumps, the vessel rooms become "machinery rooms" based on the definition of a machinery room included in IIAR 2-2008 (including Addendum A). As such, the ventilation requirements for these spaces become identical to machinery rooms.*

*Deviation (Y)* *Section 1.6.4 of Specification 15685 restricts the calculation of the ventilation rate based on the charge of refrigerant within vessels contained in the machinery room. This calculation is not consistent with ASHRAE 15 or the other codes that use a parallel requirement. The refrigerant quantity should be "the mass of refrigerant in the largest system, any part of which is located in the machinery room."*

Attached to this report is an electronic version of Specification 15685 that includes comments, additions, deletions, and other recommended revisions.

## Other

In this section, recent changes to RAGAGEP are highlighted in an effort to ensure that future refrigeration systems are designed and installed to be consistent with these new code/standard changes. In a number of cases, the items noted below did not logically fit into one of the engineering specifications provided for this review process.

*Recommendation (13)* ***Emergency pressure control system (EPCS)***

*Section 1105.9 of the IMC (2012) requires the installation of an EPCS in accordance with Section 606.10 of the International Fire Code. This applies to refrigeration systems containing more than 6.6 lb of flammable, toxic, highly toxic, or ammonia. Section 606.10 reaffirms the applicability to include flammable, toxic, and ammonia refrigerants and further requires the EPCS to be implemented in accordance sections 606.10.1 and 606.10.2 of the IFC. The 2008 edition of IIAR 2 added informative Appendix K with additional guidance on the EPCS.*

*This reviewer highly recommends that Tyson Foods consider the IFC requirements and the informative Appendix K of IIAR for systems that that will be modified or otherwise include an EPCS but use the PHA process [1910.119(e)] as a guiding framework to modify, as-required, the provisions of the code for this engineered safety. There are cases where implementing the requirements of the EPCS as-presented will actually increase risks and hazards of ammonia releases. It will be essential to look at each of the specific overpressure situations where such an engineered safety would be* *actuated and to evaluate whether the actuation of the cross-over valve itself will reduce or increase hazard. The sequences of control for all phases of the EPCS need to be reviewed carefully to ensure safe operation for each given refrigeration system application and those sequences modified as-necessary to control potential hazards.*

*Recommendation (14)* *There are other machinery room-related requirements that need to be captured in either standard design or engineering specifications to be consistent with RAGAGEP including:*

***Access*** *– Section 1106.3 of the UMC (2012) prescribes minimum clearance requirements for refrigeration equipment. In addition, Section 1112.3 of the UMC (2012) requires that stop valves required by Section 1112.0 be readily accessible from the refrigerating machinery room floor or a level platform. This is related to Deviation (B).*

***Illumination*** *– Section 1106.4 of the UMC (2012) establishes minimum requirements for lighting.*

***Refrigerant charging port protection*** *– Addendum d to ASHRAE 15-2010, Section 1101.10 of IMC (2012), and Section 1106.14 of the UMC (2012) have added provisions that requires securing of refrigerant charging port locations with locking-type tamper-resistant caps or other means to prevent unauthorized access.*

END OF REPORT

# Appendix A

## Reviewed Specifications with Mark-ups

| Number | Description | Marked-up file |
|---|---|---|
| 15600 | GENERAL PROVISIONS FOR REFRIGERATION PIPING & SYSTEM INSTALLATION | 15600 |
| 15601 | IDENTIFICATION OF AMMONIA REFRIGERATION PIPING AND SYSTEM COMPONENTS | 15601 |
| 15602 | AMMONIA REFRIGERATION PRESSURE PIPING AND UTILITY PIPING | 15602 |
| 15603 | AMMONIA REFRIGERATION INSULATION | 15603 |
| 15604 | AMMONIA REFRIGERATION WELDING/NDE REFRIGERATION PIPING | 15604 |
| 15684 | GUIDELINES FOR AMMONIA DETECTION SYSTEMS | 15684 |
| 15685 | VENTILATION DESIGN CRITERIA FOR NEW AND EXISTING AMMONIA MACHINERY ROOM AND VESSEL ROOM | 15685 |

# END OF DOCUMENT